1. Use the differential area d**S** to calculate the area of the surface defined by $\rho = 5$, $\pi/2 < \phi > \pi$, and $-2 < z < 2$. [5]

2. Convert the vector $\mathbf{P} = y^2\mathbf{p}_x + (x+1)\mathbf{p}_y + yz\mathbf{p}_z$ into cylindrical coordinates. [5]

3. Given two points, namely $A(2, 60°, 2)$ and $B(2\sqrt{3}, 30°, 3)$, find the corresponding position vectors **A** and respectively **B**. Then find the unit vector in the direction from **A** to **B**.

4. Find $\nabla^2\mathbf{B}$ when $\mathbf{B} = r^2\mathbf{b}_r + \sin\theta\mathbf{b}_\theta + \cos^2\theta\mathbf{b}_\phi$.